Question: What is momentum?

- It's like a force that starts movement
- force that keeps obj. moving after F_A stops
- increased force due to acceleration
- increased or decreased on slopes
- (mass)(velocity)
- force object has while moving
- related to inertia
- more mass, more momentum
- transferrable
- depends on mass of object

Momentum

- intrinsic property of any object
  - ↳ base characteristic
- it is not a force
- $\bar{p} = m\bar{v}$
  - ↳ momentum; it's a vector
- units: $kg \cdot m/s$
- Relationship of force and momentum

$$\Sigma \bar{F} = m\bar{a} \qquad \bar{a} = \frac{\Delta \bar{v}}{\Delta t}$$

$$\Sigma \bar{F} = m\frac{\Delta \bar{v}}{\Delta t} \qquad \Delta \bar{p} = m\Delta \bar{v}$$

$$\Sigma \bar{F} = \frac{\Delta \bar{p}}{\Delta t}$$

$$\Delta \bar{p} = \Sigma \bar{F}\,\Delta t$$

↳ Impulse

- Impulse: $\bar{J} = \bar{F}\Delta t$
- Impulse-Momentum Theorem:

$$\bar{J} = \Delta \bar{p}$$

$$\bar{F}\Delta t = m\Delta \bar{v}$$

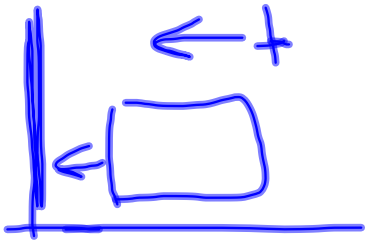
$$\bar{F}(t_f - t_i) = m(\bar{v}_f - \bar{v}_i)$$

What are implications of impulse-momentum theorem?

- greater the momentum, greater the force
- changes in impulse/momentum change distance obj. moves
- useful in forensics
- greater mass, greater momentum
- sport science uses in calculations

- Airbags
- Driving with heavier loads
- Skimboarding
- Speeding
- "Fluffy people"

A 1400 kg car moving westward with a velocity of 15 m/s collides with a utility pole and is brought to rest in 0.30 s. Find the force exerted on the car during the collision.



$\bar{v}_i = +15\ m/s$

$\bar{v}_f = 0\ m/s$

$\Delta t = 0.3\ s$

$m = 1400\ kg$

$\bar{F}\Delta t = m\Delta\bar{v}$

$$\bar{F} = \frac{m\Delta\bar{v}}{\Delta t} = \frac{m(\bar{v}_f - \bar{v}_i)}{\Delta t}$$

$$= \frac{(1400\ kg)[0\ m/s - (+15\ m/s)]}{0.30\ s}$$

$$= -70\,000\ N$$

$$(15\ m/s)\left(\frac{1\ km}{1000\ m}\right)\left(\frac{.62\ mi}{1\ km}\right)\left(\frac{3600\ s}{1\ hr}\right) = 33\ mi/hr$$